FORM PTO-1390 (REV. 11-2000) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY 'S DOCKET NUMBER: 2591-1-002

U S APPLICATION NO (If known, see 37 CFR 1 5): 09/889534

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/ES99/00382	November 25, 1999	January 18, 1999

TITLE OF INVENTION: HIGH VOLTAGE TRANSFORMER

APPLICANT(S) FOR DO/EO/US: Angel DIAZ CARMENA

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is attached hereto (required only if not communicated by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [X] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [X] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [X] are attached hereto (required only if not communicated by the International Bureau).
   b. [X] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [X] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (UNEXECUTED)
10. [X] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [ ] Other items or information:

Two (2) sheets of drawings; 1st Pg. of Published Application; International Search Report; International Preliminary Examination Report; Written Opinion and Response

EXPRESS MAIL "MAILING CERTIFICATE NO.": EL806483453 DATE OF DEPOSIT: JULY 18, 2001

JC18 Rec'd PCT/PTO 1 8 JUL 2001

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/889534	PCT/ES99/00382	2591-1-002

21. ☒ The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1000.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 1,000.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	9 - 20 =	0	x **$18.00**	$	
Independent claims	1 - 3 =	0	x **$80.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$270.00**	$ 270.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1,270.00	
☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. +				$ 635.00	
SUBTOTAL =				$ 635.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$ 635.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 635.00	
				Amount to be refunded:	$
				charged:	$

a. ☒ A check in the amount of $ 635.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-1153 . A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

DAVID A. JACKSON
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SIGNATURE

DAVID A. JACKSON
NAME

26,742
REGISTRATION NUMBER

EXPRESS MAIL "MAILING CERTIFICATE NO.": EL806483453 US DATE OF DEPOSIT: JULY 18, 2001

PATENT
2591-1-002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS : Ángel DÍAZ CARMENA

APPLICATION NO. : PCT/ES99/00382

FILED : November 25, 1999

FOR : HIGH VOLTAGE TRANSFORMER

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
BOX PCT
WASHINGTON, D.C. 20231

Sir:

Prior to the entry into the National Phase of the above-identified Application, please amend the claims as follows:

IN THE CLAIMS:

Please amend Claims 1 and 5 as follows:

1. (Amended) A high voltage transformer comprising the conventional elements for voltage transformers, said conventional elements being at least

a high tension transformer (1, 1'),

a rectifier (2, 2'),

a filter (3, 3'),

a resistive divider (4, 4),

a high voltage switch (5, 5'),

a magnetic core (7, 7'),

a low voltage input (10),

said high voltage transformer characterized in that,

each of the conventional (1-5 and 7) and 1'-5' and 7') elements has a first end and a second end opposite to the first end, with the first ends of all elements connected to ground level, that is to say, zero voltage,

said conventional elements are arranged in two differentiated groups, on the one hand the elements with positive voltages (1-5 and 7) and, on the other, the elements with negative voltages (1'-5' and 7')

the elements with positive voltages (1-5 and 7) are separated from the elements with negative voltages (1'-5' and 7') by solid insulating means,

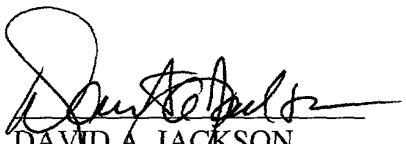
the voltage in each of said conventional elements progressively increases towards the opposed second end in the elements with positive voltages and progressively decreases in the elements with negative voltages, all this in such a manner that, at an equal distance from the ground level, the elements of each group have equipotential voltages.

5. (Amended) A high voltage transformer according to any of claims 1-3 or 4, characterized in that the maximum level of potential is defined at the lower ends of the high voltage switches (5,5').

REMARKS

The above amendment is submitted herewith to reduce multiple dependencies and to conform the claims more closely to U.S. practice. In addition, the Specification has been amended during International processing and certain of the pages thereof were revised and submitted as amended pages, which amended pages were accepted by the International Authority. To assure that the most current and accurate copy of the instant application is placed before the Examiner for substantive consideration, Applicants submit herewith a full copy of the International Application which includes all of the amendments made during International Phase. The changes made during International processing are believed to be appropriate and are not believed to raise the issue of new matter, and entry and favorable consideration and substantive examination thereof is accordingly requested.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Claims 1 and 5 have been amended as follows:

1. (Amended) A high voltage transformer comprising the conventional elements for voltage transformers, said conventional elements being at least

a high tension transformer (1, 1'),

a rectifier (2, 2'),

a filter (3, 3'),

a resistive divider (4, 4),

a high voltage switch (5, 5'),

a magnetic core (7, 7'),

a low voltage input (10),

said high voltage transformer characterized in that,

each of [said] the conventional (1-5 and 7) and 1'-5' and 7')elements has a first end and a second end opposite to the first end, with the first ends of all elements connected to ground level, that is to say, zero voltage,

said conventional elements are arranged in two differentiated groups, on the one hand the elements with positive voltages (1-5 and 7) and, on the other, the elements with negative voltages (1'-5' and 7')

the elements with positive voltages (1-5 and 7) are separated from the elements with negative voltages (1'-5' and 7') by solid insulating means,

the voltage in each of said conventional elements progressively increases towards the opposed second end in

the elements with positive voltages and progressively decreases in the elements with negative voltages[;], all this in such a manner that, at an equal distance from the ground level, the elements of each group have equipotential voltages.

5. (Amended) A high voltage transformer according to any of [the preceding] claims 1-3 or 4, characterized in that the maximum level of potential is defined at the lower ends of the high voltage switches (5,5').

COMPLETE TEXT INCLUDING ALL THE AMENDMENTS MADE DURING INTERNATIONAL PHASE

HIGH VOLTAGE TRANSFORMER

OBJECT OF THE INVENTION

The invention that is being dealt with consists in a high voltage transformer the goal of which is to considerably reduce the size and the price thereof.

Obviously, the invention can be used in all those applications where a high kilovoltage supply is being required, both in direct and in high or low frequency alternate current.

BACKGROUND OF THE INVENTION

Conventionally, the use of high kilovoltage transformers the design of which presents a maximum difficulty in achieving the electrical insulation between the various elements (transformers, high voltage switches, rectifiers, voltage dividers, dischargers, etc.) they are composed of, is more than known. Insulation thereof is conventionally made by three different manners:

1. Filling, at vacuum and in a dry environment, the whole inside of the tank or housing containing the various elements of the transformer with a liquid or gaseous fluid which is usually silicone oil or mineral oil due to the low cost thereof.

2. Using solid insulating parts as there are plastics, glasses, porcelains, resins, etc.

3. Vacuum encapsulating the whole assembly with high voltage insulating silicones or resins.

In any of these three manners of making the insulation, it is necessary to keep some minimum distances between the various elements composing the transformer. This minimum distance depends on the voltage applied between the various elements so that it is necessary to keep a minimum insulation distance between the points of major voltage, which involves in the majority of the cases, the insulation distance becomes excessive for achieving insulation between the points of minor voltage.

The final consequence is that the elements occupy a very high volume, whereby this volume must moreover be covered with the insulating material, a fact which considerably increases the weight and, especially, increases the cost of the transformer.

Furthermore, this design for achieving minimum distances, renders the assembly of the various elements of the transformer difficult, a fact which equally increases its cost.

The United States patent 4,587,606 describes a secondary winding divided into a plurality of sections provided around a primary winding of the air-core type. First and second diode groups are disposed on four substrates which surround the secondary winding. Diodes in each of the first and second diode groups are disposed on two adjacent substrates so that these diodes are connected in series so as to have the same polarity direction, respectively.

The first and second diode groups are respectively divided into a plurality of diode sections. Winding start ends and winding finishing ends are coupled between the respective two adjacent diode sections.

The diode sections disposed on each substrate are arranged to be spaced apart along the axial direction of the primary winding. One of the diode sections to which induced voltages of the winding sections are applied is disposed on two adjacent substrates, and the other diode section is disposed on the other two adjacent substrates. Positions of these diode sections are shifted along the axial direction of the primary winding. Therefore, the diode sections to which the induced voltages of the winding sections are applied are disposed on different substrates and are not on the same plane.

The Japanese patent application 6333754 A describes a transformer for cycloconverter to provide a transformer

with equal factors of resistance and leakage reactance in positive and negative groups of windings.

In a first constitution, a conductor in a positive group winding and a conductor in a negative group winding are turned double in an axial direction on a core leg at the same time.

In a second constitution, the positive group winding and the negative group winding are put on separate divisions in an axial direction of the core leg. Then, a power-supply winding is split into two and they are mounted around each outer boundary of the positive and negative group windings.

DESCRIPTION OF THE INVENTION

To solve the afore indicated inconveniences, the invention has developed a new high voltage transformer which is characterized in that the conventional elements it is constituted of are arranged in two differentiated groups, on the one hand the elements having positive voltage and, on the other, the elements having negative voltages, both groups being separated by insulating means.

Furthermore, the arrangement of the elements provides that they are advantageously designed in such a manner that one of the ends of all thereof, have ground level or "zero" voltage. This voltage progressively increases towards the opposed end in the elements having positive voltages, and progressively decreases in the elements having negative voltages; all this in such a manner that, at an equal distance from ground level, the elements of each group have equipotential voltages.

This structure has the great advantage that the elements of one same group do not need insulation between themselves, so that the distance which is to separate them is considerably reduced, and, furthermore, the elements occupying the same area of potential do not at all have an influence on the stray capacitance, so that there are no

limitations neither in respect of their proximity nor in respect of the opposed surfaces between them.

Thus, by means of the invention, as the elements are designed such that their voltage levels are in accordance with the area of potential which they occupy, it is possible to bring the elements nearer to each other, so that the volume is considerably reduced and, thus, the insulator filling the inside of the housing or tank of the transformer, is considerably reduced.

As a consequence of this reduction of the volume, a considerable reduction of the weight is achieved, due to the fact that the tank is of smaller dimensions and a smaller quantity of filling insulator is required.

Another of the advantages of the present invention is the reduction of the stray capacitance which eliminates some undesirable side effects.

The progressive increase of the voltage in the elements having a positive voltage, and the progressive decrease of the voltage in the elements having a negative voltage, are linear.

Advantageously, the ground level or "zero voltage", is located in the area where the low voltage input signals are located.

In a preferred embodiment, the "zero voltage" level is located on the upper side of the transformer, such that the maximum level of potential is defined at the lower ends of the high voltage switches.

The insulating means separating the two groups of elements, are established by one single solid insulating means, a fact which considerably simplifies the assembly of the various elements of the transformer at the same time as it reduces its cost.

Another feature of the invention resides in the fact that it has means for minimizing the stray capacitance between the elements of one group and the elements of the

other. These means are determined by the arrangement presented by the various elements of one group and the other; said elements are located in such a way that the surface of the elements of one group opposed to the surface of the elements of the other group, is minimum.

By means of the invention, the number of supporting and electrical insulation parts as well as manpower needed for assembling is reduced.

As a consequence of the above, it is evident that the invention considerably reduces the total cost of the tank, as well as that of the storage and transport thereof.

Hereafter, so as to facilitate a better understanding of this description and forming an integral part thereof, a series of figures in which the object of the invention is represented in an illustrative, non-limiting way, is attached hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic top plan view of a possible embodiment of the transformer of the invention. In this figure the upper surface or cover of the housing or tank of the transformer has been removed.

Figure 2 shows a side view of the transformer shown in the preceding figure, in which the lateral surface has been removed so as to clearly appreciate the arrangement of the various elements.

Figure 3 shows a view in accordance with section A-B of the preceding figure.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Hereinafter, a description of the invention will be made on the basis of the aforementioned figures.

The transformer of the invention presents as a characteristic the fact that the conventional elements it is comprised of, are arranged in two differentiated groups, in such a manner that, on one side, there are situated the elements with positive voltages and, on the

other, the elements with negative voltages.

For this purpose, in a longitudinal half of the transformer there are arranged: a high voltage transformer 1 with its magnetic core 7, a rectifier 2, a filter 3, a resistive divider 4 and an anode switch 5 which constitute the elements supporting positive voltages.

In the other longitudinal half, there are arranged, a high voltage transformer 1' with its magnetic core 7', a rectifier 2', a filter 3', a resistive divider 4', and the cathode switch 5' which constitute the elements supporting negative voltages.

Between both groups, there is arranged a solid insulating means (6) furnishing correct insulation between the two groups, whereas insulation between the various elements of each group is achieved by means of a fixing to a "zero voltage" or ground level on the upper side, which is progressively increased towards the lower end in the elements with positive voltage and which progressively decreases in the elements with negative voltages, in such a way that at one same distance from ground level, the elements of each group have equal voltages as represented in figures 2 and 3 wherein voltage levels of 0 ± 20kV, ± 40kV, ± 80kV have been marked.

Hereby, the potential becomes linearly increased as from the level of 0 Volt downwards, whereby the maximum level of potential is defined by the lower ends of the switches 5 and 5'.

Achievement of equipotential levels permits the elements occupying the same level of potential to be brought near to each other until almost contacting each other, as they do not need insulators and do not at all have an influence on the stray capacitance, and there are thus no limitations neither in respect of their proximity nor in respect of the opposed surfaces therebetween, so that the total volume of the transformer is considerably

reduced.

Furthermore, as can be appreciated in figure 1, the surface of the elements of one group being opposed to the opposite surface of the elements of the other group, is minimum, such that the stray capacitances are minimized.

All described elements remain included in housing 8 which is closed at its upside by cover 9 constituting the point of zero voltage wherein low voltage input 10 is arranged. Said low voltage input is negligible when compared to the high voltage being generated at the various levels, and can therefore be considered as zero voltage level.

As has been described before in chapter Background of the Invention, the inside of the tank or housing 8 is filled with an insulating material which in the embodiment is silicone oil or mineral oil, and as a matter of example it may be pointed out that the amount of this insulator needed for filling the whole of the volume, is of 4 liters which in comparison to the 36 liters needed by conventional transformers, represents a very high reduction in volume with the subsequent saving represented thereby.

Obviously, as already stated in chapter Background of the Invention, the insulator being used can be materialized by means of vacuum encapsulating the whole of the assembly with high voltage insulating silicones or resins.

CLAIMS

1. A high voltage transformer comprising the conventional elements for voltage transformers, said conventional elements being at least

a high tension transformer (1, 1'),
a rectifier (2, 2'),
a filter (3, 3'),
a resistive divider (4, 4),
a high voltage switch (5, 5'),
a magnetic core (7, 7'),
a low voltage input (10),

said high voltage transformer characterized in that,

each of ~~said~~ the conventional elements (1-5 and 7 and 1'-5' and 7') has a first end and a second end opposite to the first end, with the first ends of all elements connected to ground level, that is to say, zero voltage,

said conventional elements are arranged in two differentiated groups, on the one hand the elements with positive voltages (1-5 and 7) and, on the other, the elements with negative voltages (1'-5' and 7')

the elements with positive voltages (1-5 and 7) are separated from the elements with negative voltages (1'-5' and 7') by solid insulating means,

the voltage in each of said conventional elements progressively increases towards the opposed second end in the elements with positive voltages and progressively decreases in the elements with negative voltages, all this in such a manner that, at an equal distance from the ground level, the elements of each group have equipotential voltages.

2. A high voltage transformer according to claim 1, characterized in that the progressive increase of the voltage in the elements with positive voltage and the progressive decrease of the voltage in the elements with

negative voltage, is linear.

3. A high voltage transformer according to claim 1, characterized in that the level of "zero voltage" is located in the area where the signals of the low voltage input (10) are located.

4. A high voltage transformer according to claim 3, characterized in that the level of "zero voltage" is located at the upper side (9) of the transformer.

5, A high voltage transformer according to any of the preceding claims, characterized in that the maximum level of potential is defined at the lower ends of the high voltage switches (5,5').

6. A high voltage transformer according to claim 1, characterized in that the two groups are separated by a single solid insulating means(6).

7. A high voltage transformer according to claim 1, characterized in that it includes means for minimizing the stray capacitances between the elements of one group and those of the other, said means being determined by an arrangement of said elements, such that the elements of one group have only a very small surface opposed to the elements of the other group.

HIGH VOLTAGE TRANSFORMER

OBJECT OF THE INVENTION

The invention that is being dealt with consists in a high voltage transformer the goal of which is to considerably reduce the size and the price thereof.

Obviously, the invention can be used in all those applications where a high kilovoltage supply is being required, both in direct and in high or low frequency alternate current.

BACKGROUND OF THE INVENTION

Conventionally, the use of high kilovoltage transformers the design of which presents a maximum difficulty in achieving the electrical insulation between the various elements (transformers, high voltage switches, rectifiers, voltage dividers, dischargers, etc.) they are composed of, is more than known. Insulation thereof is conventionally made by three different manners:

1. Filling, at vacuum and in a dry environment, the whole inside of the tank or housing containing the various elements of the transformer with a liquid or gaseous fluid which is usually silicone oil or mineral oil due to the low cost thereof.

2. Using solid insulating parts as there are plastics, glasses, porcelains, resins, etc.

3. Vacuum encapsulating the whole assembly with high voltage insulating silicones or resins.

In any of these three manners of making the insulation, it is necessary to keep some minimum distances between the various elements composing the transformer. This minimum distance depends on the voltage applied between the various elements so that it is necessary to keep a minimum insulation distance between the points of major voltage, which involves in the majority of the cases, the insulation distance becomes excessive for achieving insulation between the points of minor voltage.

The final consequence is that the elements occupy a very high volume, whereby this volume must moreover be covered with the insulating material, a fact which considerably increases the weight and, especially, increases the cost of the transformer.

Furthermore, this design for achieving minimum distances, renders the assembly of the various elements of the transformer difficult, a fact which equally increases its cost.

The United States patent 4,587,606 describes a secondary winding divided into a plurality of sections provided around a primary winding of the air-core type. First and second diode groups are disposed on four substrates which surround the secondary winding. Diodes in each of the first and second diode groups are disposed on two adjacent substrates so that these diodes are connected in series so as to have the same polarity direction, respectively.

The first and second diode groups are respectively divided into a plurality of diode sections. Winding start ends and winding finishing ends are coupled between the respective two adjacent diode sections.

The diode sections disposed on each substrate are arranged to be spaced apart along the axial direction of the primary winding. One of the diode sections to which induced voltages of the winding sections are applied is disposed on two adjacent substrates, and the other diode section is disposed on the other two adjacent substrates. Positions of these diode sections are shifted along the axial direction of the primary winding. Therefore, the diode sections to which the induced voltages of the winding sections are applied are disposed on different substrates and are not on the same plane.

The Japanese patent application 6333754 A describes a transformer for cycloconverter to provide a transformer

with equal factors of resistance and leakage reactance in positive and negative groups of windings.

In a first constitution, a conductor in a positive group winding and a conductor in a negative group winding are turned double in an axial direction on a core leg at the same time.

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DESCRIPTION OF THE INVENTION

To solve the afore indicated inconveniences, the invention has developed a new high voltage transformer which is characterized in that the conventional elements it is constituted of are arranged in two differentiated groups, on the one hand the elements having positive voltage and, on the other, the elements having negative voltages, both groups being separated by insulating means.

Furthermore, the arrangement of the elements provides that they are advantageously designed in such a manner that one of the ends of all thereof, have ground level or "zero" voltage. This voltage progressively increases towards the opposed end in the elements having positive voltages, and progressively decreases in the elements having negative voltages; all this in such a manner that, at an equal distance from ground level, the elements of each group have equipotential voltages.

This structure has the great advantage that the elements of one same group do not need insulation between themselves, so that the distance which is to separate them is considerably reduced, and, furthermore, the elements occupying the same area of potential do not at all have an influence on the stray capacitance, so that there are no

limitations neither in respect of their proximity nor in respect of the opposed surfaces between them.

Thus, by means of the invention, as the elements are designed such that their voltage levels are in accordance with the area of potential which they occupy, it is possible to bring the elements nearer to each other, so that the volume is considerably reduced and, thus, the insulator filling the inside of the housing or tank of the transformer, is considerably reduced.

As a consequence of this reduction of the volume, a considerable reduction of the weight is achieved, due to the fact that the tank is of smaller dimensions and a smaller quantity of filling insulator is required.

Another of the advantages of the present invention is the reduction of the stray capacitance which eliminates some undesirable side effects.

The progressive increase of the voltage in the elements having a positive voltage, and the progressive decrease of the voltage in the elements having a negative voltage, are linear.

Advantageously, the ground level or "zero voltage", is located in the area where the low voltage input signals are located.

In a preferred embodiment, the "zero voltage" level is located on the upper side of the transformer, such that the maximum level of potential is defined at the lower ends of the high voltage switches.

The insulating means separating the two groups of elements, are established by one single solid insulating means, a fact which considerably simplifies the assembly of the various elements of the transformer at the same time as it reduces its cost.

Another feature of the invention resides in the fact that it has means for minimizing the stray capacitance between the elements of one group and the elements of the

other. These means are determined by the arrangement presented by the various elements of one group and the other; said elements are located in such a way that the surface of the elements cf one group opposed to the surface of the elements of the other group, is minimum.

By means of the invention, the number of supporting and electrical insulation parts as well as manpower needed for assembling is reduced.

As a consequence of the above, it is evident that the invention considerably reduces the total cost of the tank, as well as that of the storage and transport thereof.

Hereafter, so as to facilitate a better understanding of this description and forming an integral part thereof, a series of figures in which the object of the invention is represented in an illustrative, non-limiting way, is attached hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

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Figure 2 shows a side view of the transformer shown in the preceding figure, in which the lateral surface has been removed so as to clearly appreciate the arrangement of the various elements.

Figure 3 shows a view in accordance with section A-B of the preceding figure.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Hereinafter, a description of the invention will be made on the basis of the aforementioned figures.

The transformer of the invention presents as a characteristic the fact that the conventional elements it is comprised of, are arranged in two differentiated groups, in such a manner that, on one side, there are situated the elements with positive voltages and, on the

other, the elements with negative voltages.

For this purpose, in a longitudinal half of the transformer there are arranged: a high voltage transformer 1 with its magnetic core 7, a rectifier 2, a filter 3, a resistive divider 4 and an anode switch 5 which constitute the elements supporting positive voltages.

In the other longitudinal half, there are arranged, a high voltage transformer 1' with its magnetic core 7', a rectifier 2', a filter 3', a resistive divider 4', and the cathode switch 5' which constitute the elements supporting negative voltages.

Between both groups, there is arranged a solid insulating means (6) furnishing correct insulation between the two groups, whereas insulation between the various elements of each group is achieved by means of a fixing to a "zero voltage" or ground level on the upper side, which is progressively increased towards the lower end in the elements with positive voltage and which progressively decreases in the elements with negative voltages, in such a way that at one same distance from ground level, the elements of each group have equal voltages as represented in figures 2 and 3 wherein voltage levels of 0 ± 20kV, ± 40kV, ± 80kV have been marked.

Hereby, the potential becomes linearly increased as from the level of 0 Volt downwards, whereby the maximum level of potential is defined by the lower ends of the switches 5 and 5'.

Achievement of equipotential levels permits the elements occupying the same level of potential to be brought near to each other until almost contacting each other, as they do not need insulators and do not at all have an influence on the stray capacitance, and there are thus no limitations neither in respect of their proximity nor in respect of the opposed surfaces therebetween, so that the total volume of the transformer is considerably

reduced.

Furthermore, as can be appreciated in figure 1, the surface of the elements of one group being opposed to the opposite surface of the elements of the other group, is minimum, such that the stray capacitances are minimized.

All described elements remain included in housing 8 which is closed at its upside by cover 9 constituting the point of zero voltage wherein low voltage input 10 is arranged. Said low voltage input is negligible when compared to the high voltage being generated at the various levels, and can therefore be considered as zero voltage level.

As has been described before in chapter Background of the Invention, the inside of the tank or housing 8 is filled with an insulating material which in the embodiment is silicone oil or mineral oil, and as a matter of example it may be pointed out that the amount of this insulator needed for filling the whole of the volume, is of 4 liters which in comparison to the 36 liters needed by conventional transformers, represents a very high reduction in volume with the subsequent saving represented thereby.

Obviously, as already stated in chapter Background of the Invention, the insulator being used can be materialized by means of vacuum encapsulating the whole of the assembly with high voltage insulating silicones or resins.

CLAIMS

1. A high voltage transformer comprising the conventional elements for voltage transformers, said conventional elements being at least

a high tension transformer (1, 1'),
a rectifier (2, 2'),
a filter (3, 3'),
a resistive divider (4, 4),
a high voltage switch (5, 5'),
a magnetic core (7, 7'),
a low voltage input (10),

said high voltage transformer characterized in that,

each of said conventional elements has a first end and a second end opposite to the first end, with the first ends of all elements connected to ground level, that is to say, zero voltage,

said conventional elements are arranged in two differentiated groups, on the one hand the elements with positive voltages (1-5 and 7) and, on the other, the elements with negative voltages (1'-5' and 7')

the elements with positive voltages (1-5 and 7) are separated from the elements with negative voltages (1'-5' and 7') by solid insulating means,

the voltage in each of said conventional elements progressively increases towards the opposed second end in the elements with positive voltages and progressively decreases in the elements with negative voltages;, all this in such a manner that, at an equal distance from the ground level, the elements of each group have equipotential voltages.

2. A high voltage transformer according to claim 1, characterized in that the progressive increase of the voltage in the elements with positive voltage and the progressive decrease of the voltage in the elements with

negative voltage, is linear.

3. A high voltage transformer according to claim 1, characterized in that the level of "zero voltage" is located in the area where the signals of the low voltage input (10) are located.

4. A high voltage transformer according to claim 3, characterized in that the level of "zero voltage" is located at the upper side (9) of the transformer.

5, A high voltage transformer according to any of the preceding claims, characterized in that the maximum level of potential is defined at the lower ends of the high voltage switches (5,5').

6. A high voltage transformer according to claim 1, characterized in that the two groups are separated by a single solid insulating means(6).

7. A high voltage transformer according to claim 1, characterized in that it includes means for minimizing the stray capacitances between the elements of one group and those of the other, said means being determined by an arrangement of said elements, such that the elements of one group have only a very small surface opposed to the elements of the other group.

1/2

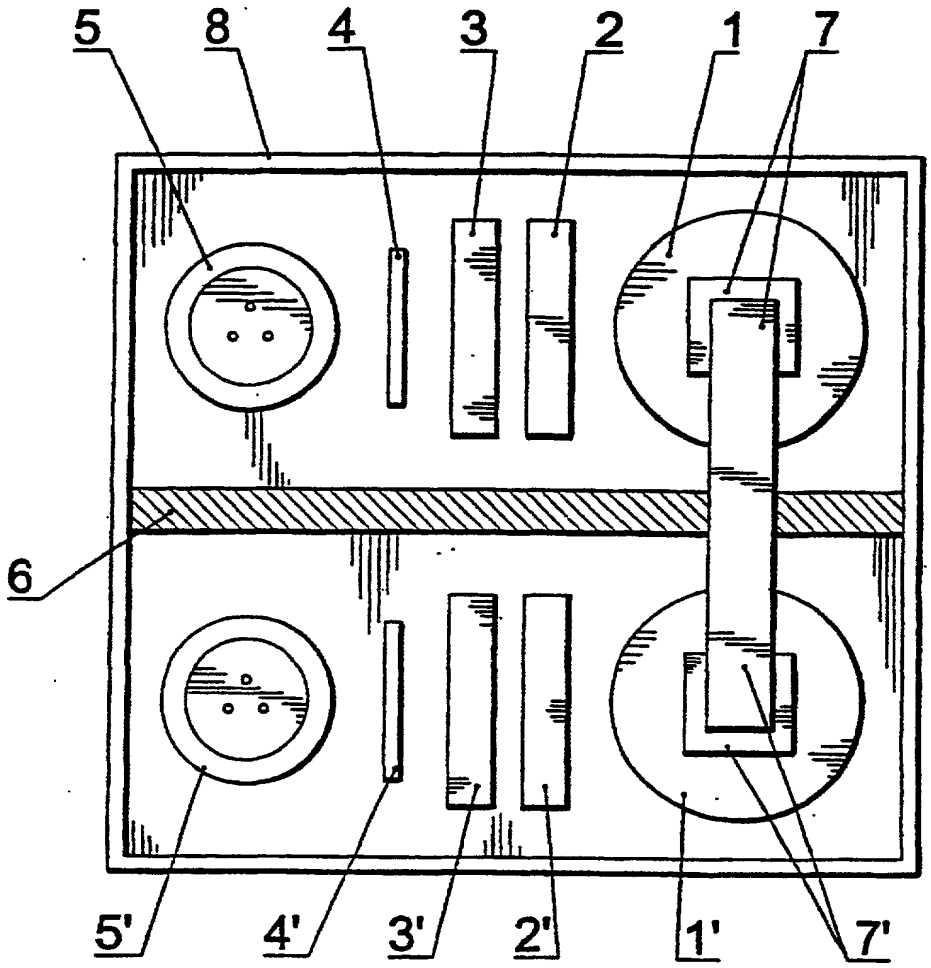

FIG. 1

2/2

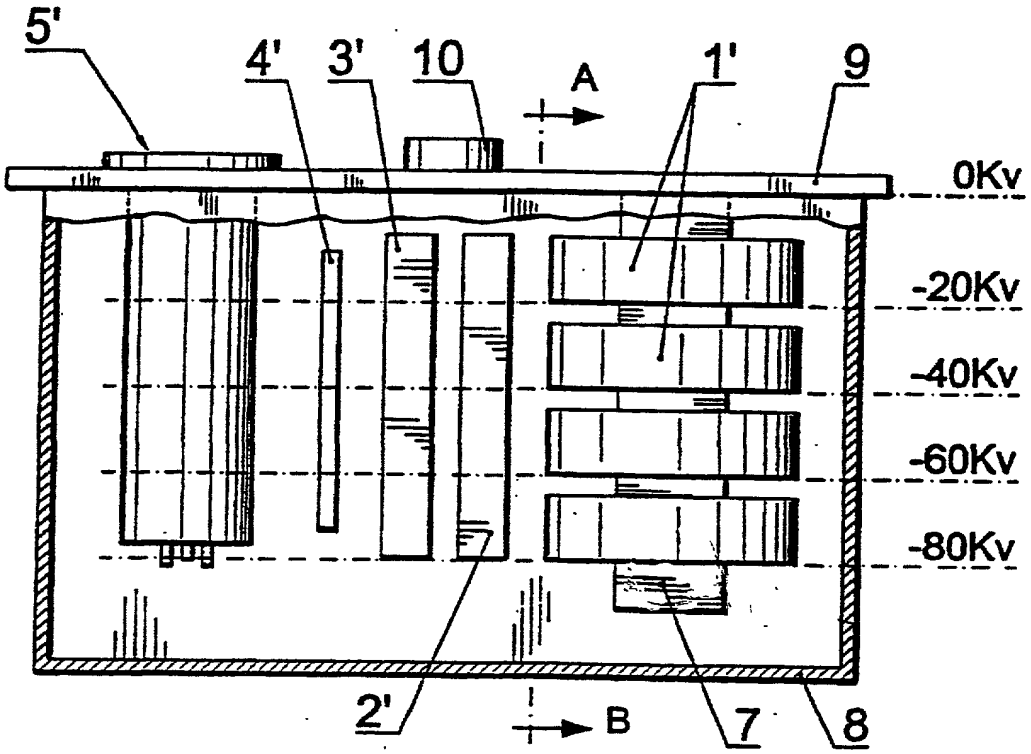
5'
4'
3'
10
A
1'
9
0Kv
-20Kv
-40Kv
-60Kv
-80Kv
2'
B
7
8

FIG. 2

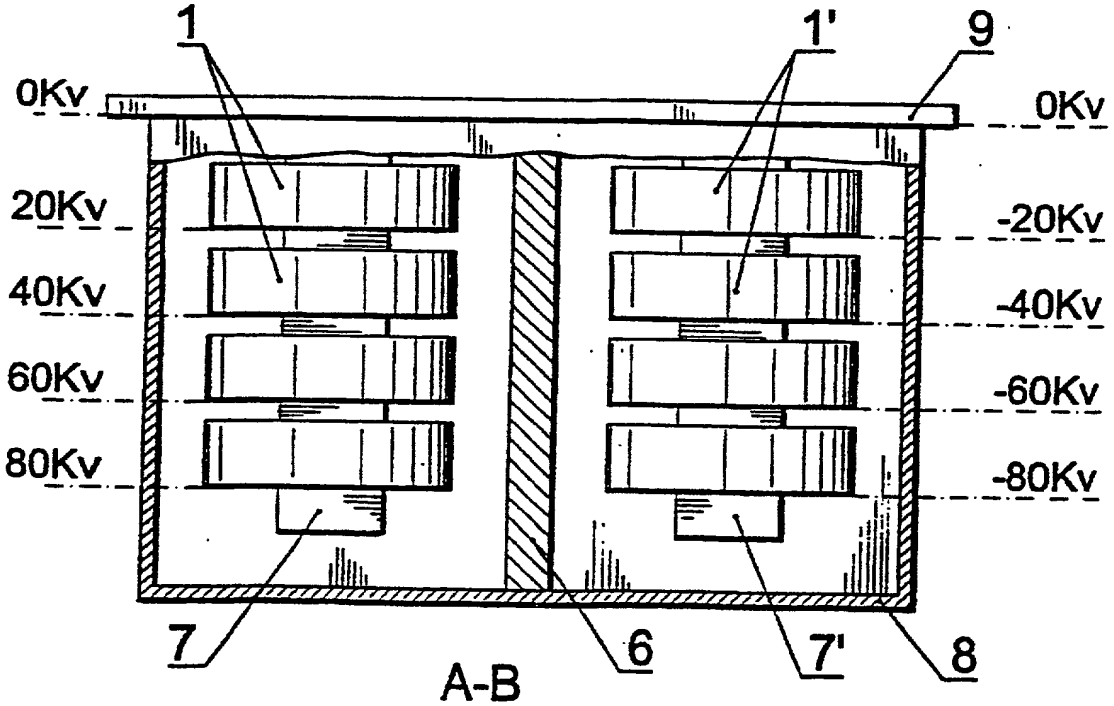
1
1'
9
0Kv
0Kv
20Kv
-20Kv
40Kv
-40Kv
60Kv
-60Kv
80Kv
-80Kv
7
6
7'
8
A-B

FIG. 3

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application No.	PCT Parent Number	Parent Filing (MM/DD/YYYY)	Parent Patent Number (if applicable)

The undersigned hereby authorizes the U.S. attorney or agent named herein to accept and follow instructions from **Ungria Patentes Y Marcas, S.A.** as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney or agent and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorney or agent named herein will be so notified by the undersigned.

I hereby appoint as my attorneys or agents the registered persons identified under

Customer No. 23565

for the law firm of Klauber & Jackson, said attorneys or agents with full power of substitution and revocation to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Please address all correspondence regarding this application to **Customer No. 23565**.

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Attorney Docket No.: 2591-1-002

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below under my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

HIGH VOLTAGE TRANSFORMER

the Specification of which

[ ] is attached hereto

[X] was filed on November 25, 1999
as International Application No. PCT/ES99/00382

I hereby state that I have reviewed and understand the contents of the above-identified Specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN FILED APPLICATION(S)

APPLICATION NUMBER	COUNTRY	(MONTH/DAY/YYYY)	PRIORITY CLAIMED
P 9900089	**SPAIN**	**January 18, 1999**	**YES**

I hereby claim the benefit under Title 35, United States Code §119(e) of any United States provisional application(s) listed below.

APPLICATION NUMBER(S)	FILING DATE (MM/DD/YYYY)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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SIGNATURE OF INVENTOR Angel Diaz Carmena

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August 31, 2001

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Assistant Commissioner for Patents
Washington, D.C. 20231

Re: International Patent Application
No. PCT/ES99/00382, now
U.S. Serial No. 09/889,534
Applicants : Ángel DÍAZ CARMENA
Title : HIGH VOLTAGE TRANSFORMER
Filing Date : July 18, 2001
Docket No. : 2591-1-002

EXPRESS MAIL "MAILING CERTIFICATE NO." : EL 920250293 US
DATE OF DEPOSIT : AUGUST 31, 2001

SUBMISSION OF MISSING REQUIREMENTS UNDER
35 U.S.C. 371 IN THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)

Dear Sir:

Responsive to the Notification of Missing Requirements Parts of Application under 35 U.S.C. 371 in the U.S. Designated/Elected Office, copy enclosed, Applicants submit herewith the following:

1. A combined Declaration and Power of Attorney making reference to the above-identified application, and in compliance with 37 CFR 1.63.

2. Check in the amount of $65.00 representing the surcharge (small entity) for late filing of the executed Declaration and Power of Attorney.

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